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No. 1689

INSTRUCTIONS FOR MOUNTING,  
USING, AND CARING FOR  
**8-INCH DISAPPEARING CARRIAGES**

L. F., MODEL OF 1894

FOR

**8-INCH GUNS, MODELS OF 1888  
1888 M<sub>I</sub>, AND 1888 M<sub>II</sub>**

(*SIX PLATES*)

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WAR DEPARTMENT,  
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*Washington, October 17, 1916.*

This manual is published for the information and government of the Regular Army and the National Guard of the United States.:

By order of the Secretary of War:

WILLIAM CROZIER,  
*Brigadier General, Chief of Ordnance.*

(3)

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## TABLE OF CONTENTS.

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	Page.
List of plates.....	7
General description.....	9
To assemble the carriage.....	18
Care of carriage.....	25
Index.....	39





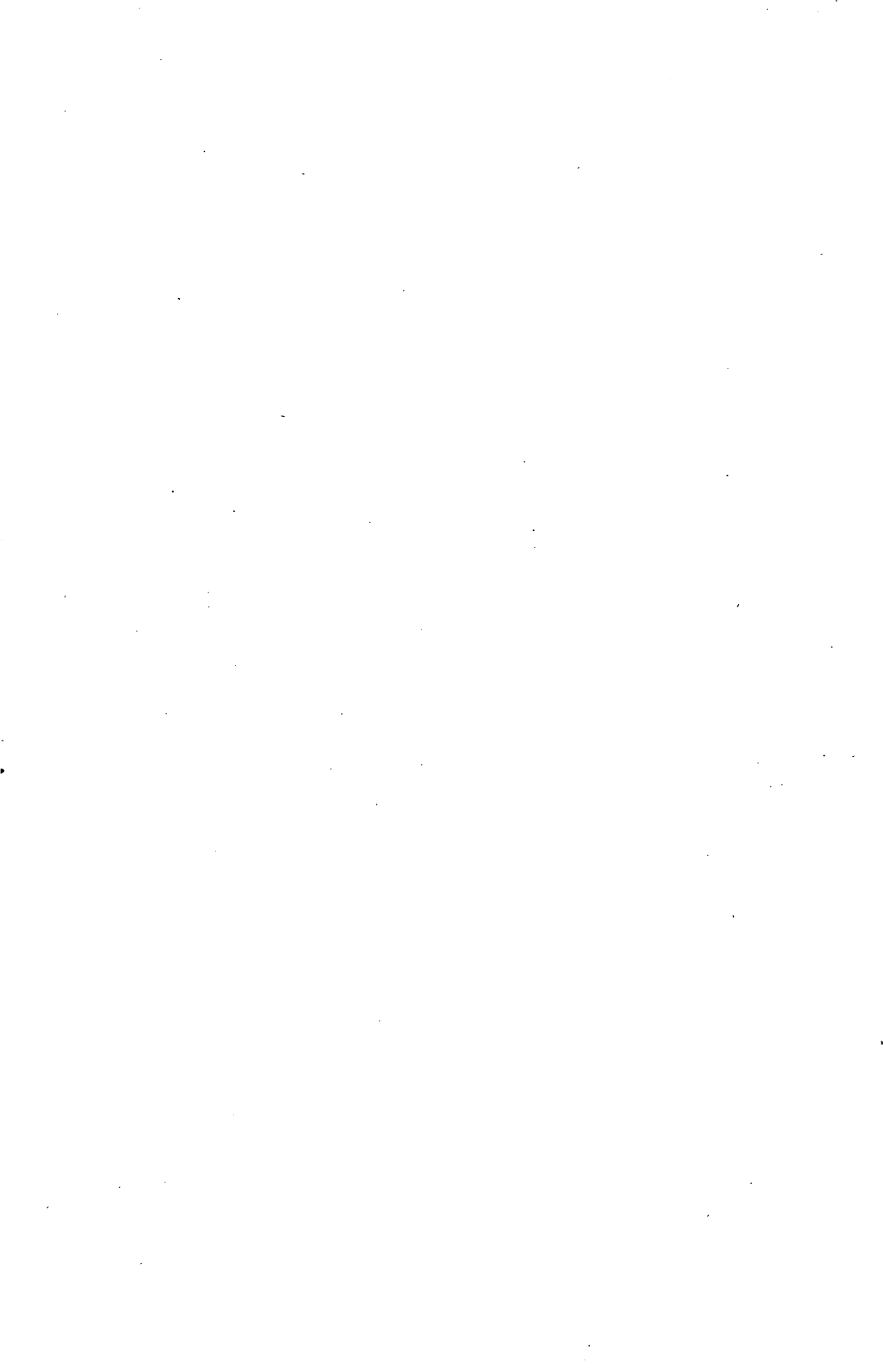
## LIST OF PLATES.

---

	Drawing No.
I. Longitudinal section.....	8-7- 1
II. End views.....	8-7- 2
III. Plan.....	8-7- 3
IV. Throttling valve.....	8-7-35
V. Ammunition truck.....	8-9-20
VI. Method of controlling energy of recoil.....	15-0- 1

[No. 1689]

(7)



UNITED STATES  
ARMY

INSTRUCTIONS FOR MOUNTING, USING, AND CARING FOR 8-INCH DISAPPEARING  
CARRIAGES, L. F., MODEL OF 1894, FOR 8-INCH GUNS, MODELS OF 1888, 1888 M<sub>I</sub>,  
AND 1888 M<sub>II</sub>.

[The parts in italics should be especially noted.]

(SIX PLATES.)

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GENERAL DESCRIPTION.

This carriage is designed to mount 8-inch guns, models of 1888, 1888 M<sub>I</sub>, and 1888 M<sub>II</sub>. It consists of the following principal parts, viz: Gun levers, counterweight, top carriage, chassis, racer, traversing rollers, base ring, transoms, traversing wheels, traversing-wheel transom, traversing circle, traversing gear, elevating arm, retracting gear, tripping gear, equalizing and throttling pipes, and ammunition trucks.

The trunnions of the guns rest in bronze-bushed trunnion beds in the upper ends of the gun levers. These levers are made of cast steel, and are pivoted near their middle points upon the gun-lever axle of forged steel, which rests in bronze-bushed axle beds in the top carriage. The lower ends of the gun levers are joined by the suspension-rod shaft, of forged steel, to the crosshead pieces to which the shaft is screwed and pinned, the whole forming the crosshead.

The counterweight bottom plate is suspended from the suspension-rod shaft by the two suspension rods, forming a cage which carries the lead counterweight. The bottom plate which bears the counterweight is made of cast iron, and is strengthened by a diametral rib. The crosshead pieces, made of cast steel, are lined with bronze and engage over crosshead guides cast on the inside of the chassis. These guides constrain the crosshead to move in a vertical direction. Ratchet teeth are cut on the front faces of the crosshead pieces to be caught by pawls pivoted on the chassis, and in this way the counterweight is held up and the gun prevented from returning to the firing position after recoiling.

The counterweight is piled in the cage in layers of different thicknesses, each layer consisting of one or more pieces. There are a number of smaller pieces on top provided with rings for easy handling. By means of these smaller weights the counterweight can readily be increased or diminished. When the counterweight is assembled it forms a cylindrical pile 3 feet 10½ inches in diameter and about 4 feet high. In its lowest position it hangs in a well formed in the

platform, concentric with the base ring, 4 feet 1½ inches in diameter and approximately 4.3 feet deep, measured from the underside of the base ring.

There are two pawls on each side to engage the ratchet teeth in the crosshead pieces. The one nearest the chassis is supported on a short axle fixed in position; the other one is mounted on a short crank actuated by a long lever at the side of the carriage; consequently, when the long lever is raised one pawl is also raised an amount depending on the length of the crank. By this arrangement if the gun has not recoiled sufficiently it may, if necessary, be brought to a more convenient position for loading. The operation may be described as follows:

After the recoil, both pawls on each side will be found engaging the same tooth in each ratchet. Men on each side of the carriage simultaneously raise the long levers, thus raising the inside pawls and, consequently, the crosshead into which they engage, until the distance through which the ratchet has moved is sufficient to enable the fixed pawls on each side to engage the next lower tooth. When this is accomplished the levers are lowered until the movable pawls engage these same teeth, and the operation is repeated until the gun has been lowered the desired amount.

After the gun is loaded it is permitted to rise to the firing position by tripping the pawls. This is done by means of small tripping bars, maneuvered simultaneously on each side of the carriage. The pawls are so arranged that when the outside pawl is tripped a projection of it bearing on the inner pawl causes the latter to be tripped at the same time. *On tripping, the pawls should be forced to the rear until the safety latch engages a pin on the outer pawl, thus preventing the pawls from reengaging the crosshead teeth during the descent of the crosshead.* When the crosshead teeth have descended beyond the danger of being engaged by the pawls a lug on the crosshead engages a safety latch, thus releasing the pawls in preparation for engaging the crosshead teeth when the crosshead shall again rise. Stops are placed on the tripping bars, so that they can bear only on the outside pawls; otherwise both pawls will not be tripped.

The top carriage is made of gun iron, cast in one piece. It consists of two axle-bed side frames, in which are cast two recoil cylinders, united by a transom. It runs upon two sets of nine forged-steel rollers, 8 inches in diameter, and mounted in U-shaped recesses in the tops of the chassis rails. The rollers are bushed with bronze and mounted upon forged-steel axles, seated with a driving fit in the walls of the recesses. Flanges upon the recoil cylinders are clipped over the chassis rails. A ratchet is formed on the underside of these clips, near their forward ends, for em-

barring the carriage into battery by means of handspikes, if from any cause it should stop short.

The recoil cylinders are  $8\frac{3}{4}$  inches in interior diameter, fitted with piston rods  $3\frac{1}{2}$  inches in diameter, having pistons formed out of the solid, and working in the cylinders with a clearance of 0.01 of an inch all around. The front ends of the piston rods pass through lugs, which project upward from the front ends of the chassis, and are secured by the piston-rod nuts and check nuts. The piston rods project through the rear ends of the cylinders, and are supported in rear by brackets bolted to the ends of the chassis rails.

A small portion of the energy of recoil is taken up by raising the counterweight, but the greater portion is controlled and taken up by the resistance of the hydraulic cylinders.

The general arrangement of the hydraulic cylinders, pistons, equalizing and connecting pipes, throttling valves, and emptying coupling of a disappearing carriage, when the gun is in the firing position, is shown on Plate VI.

When the gun is fired the pistons remain stationary, while the top carriage moves to the rear. The motion of the top carriage is retarded, and finally stopped, by the resistance which the oil in the cylinders offers to being forced from one side of the piston to the other through the following openings:

1. The constant clearance necessary for working movement between the piston and the walls of the cylinder.
2. The orifices between the throttling bars and their slots in the pistons, which vary in area with the profile of the throttling bars.
3. The opening in the throttling valve, the area of which depends upon the adjustment of the valve. This area is constant during recoil, but can be changed to suit different conditions of loading and to correct for any other conditions that would cause a variation in the length of recoil.

There are two throttling bars in each cylinder, passing through slots in the piston. These bars are constructed so that the area of orifices for the escape of the oil through the slots in the piston is constant from the beginning of motion to the point where the velocity of retarded recoil of the top carriage is a maximum. After this point the area of orifices diminishes continually until zero at the end of the recoil, so as to give a constant resistance to the motion of the top carriage.

The areas of the orifices have been calculated for a particular set of conditions of loading, and any variation in these conditions will change the length of recoil. As the standard conditions of loading are not always used, it has been found desirable to provide means for varying the resistance of the hydraulic cylinders, in order that the

prescribed length of recoil may be obtained, as, for example, when practice charges are fired.

For this purpose the throttling valve is provided, *which can be adjusted to give openings, varying by 0.0133 square inch, from 0 to 0.40 square inch.* The graduations of the valve are stamped on the top of the body, and one revolution of the yoke varies the area of the opening 0.0266 of a square inch. One revolution of the yoke changes the length of recoil by the equivalent of about two notches in the crosshead.

*For full charges the valve should be opened about 0.10 of a square inch, but not more, unless the necessity for it is shown by previous firings.* For reduced charges the opening should be sufficiently increased to permit the gun to recoil to a convenient loading position. The opening of the valve best suited for firing with full and also with reduced charges should be determined during actual practice and from records kept for future reference.

A padlock is provided for locking the valve yoke in any position to guard against accidental or unauthorized changes in valve setting.

*From the foregoing it is evident that, should the recoil of the top carriage not be sufficiently great, the proper correction is by an increase in the opening in the throttling valve, and not by a decrease in the counterweight.* Conversely, should the top carriage recoil too freely, the valve opening should be diminished instead of increasing the counterweight.

To secure equal resistance in each cylinder an equalizing pipe connects the front or pressure ends of the cylinders, and when the throttling valve is open, connects through it with the rear ends of the cylinders, thus reducing the resistance in front of the piston. The cylinders are provided with filling plugs, and an emptying plug is placed in the coupling of the equalizing pipe.

The counter-recoil buffers consist of bronze cylinders screwed into the front part of the rear cylinder heads and of cylindrical lugs on the rear faces of the pistons. When the gun is returned to the firing position, the oil caught in the cylinders can only escape through the small clearance between the two parts of the buffer and the return is thus stopped at the proper point. *When the gun is returned to the proper position for firing, the top carriage abuts against the counter-recoil stops at the front end of the chassis rails, which also prevent the male part of the buffer from bottoming in the female.*

Chassis of cast steel are bolted to the racer in front and to the traversing-wheel transom in rear. They are also united near their middle part by two cast-steel transoms. When in place, the upper surfaces of the chassis rails have a slope of 2 degrees to the front to facilitate the return of the gun to the firing position, and to reduce the preponderance of counterweight.

Recoil buffers are placed in rear on brackets cast on the chassis. When there is a space of  $1\frac{1}{2}$  inches between these buffers and the gun levers, the gun is in its calculated loading position, *below which it should not be retracted*. By a proper adjustment of the throttling valve the recoil of the gun should not vary much from this position.

The ammunition truck will, however, permit the gun to be loaded at a position about 20 inches higher than this.

The racer is made of steel cast in one piece, having an outside diameter of 8 feet. On the underside there is an annular projection 2 inches thick, which is accurately bored to an inside diameter of 5 feet 6 inches. This annular projection fits over a corresponding projection from the base ring, forming a pintle whose outside diameter is bored so that there is a diametral clearance of 0.03 of an inch between the two surfaces. The upper roller path is also formed on the underside of the racer. The pintle surface of the racer contains a spiral groove for facilitating lubrication, for which purpose there are a number of suitably placed oil holes on top of the racer.

The racer rests upon a circle of eighteen conical traversing rollers, held in place by two concentric wrought-iron distance rings. This system rests upon the lower roller path and is held concentric by flanges on the inner ends of the rollers. The rollers are made of forged steel and are 5.04 inches in diameter at the small end. A heavy clip is bolted to the top face of the racer in front and engages under an interior flange formed on the base ring. There is a dust guard outside of the roller-ring system, formed in three sections of steel plate and bolted to the racer. This should be occasionally removed to inspect and clean the rollers and roller paths.

The base ring, made of gun iron in one piece, is bolted to the platform by sixteen  $1\frac{1}{2}$ -inch bolts. It contains, in addition to the pintle, the lower roller path formed on its upper surface. Leveling screws are provided for the base ring and traversing circle, and are also used to relevel these parts in case the platform settles out of level.

The rear part of the carriage is carried by four conical traversing wheels of cast steel, whose axles rest in roller bearings. These wheels travel on a traversing circle of gun iron made in four segments, forming a semicircle and bolted to the platform by  $1\frac{1}{2}$ -inch bolts. The segments are joined together by joint plates. The outside diameter of the traversing circle is 20 feet 8 inches, and the ends are provided with wedge-shaped stops for the traversing wheels.

A brass azimuth circle, placed on the top face of the traversing circle in rear of the wheel path, is graduated to degrees, but the numbers are to be added after the carriage is in its emplacement. An azimuth pointer and subscale is attached to the traversing-wheel transom. It has slotted holes to give it lateral motion for

adjustment, after which it is fixed in position by two dowels. A screw vernier is provided by which the azimuth may be read to 0.01 of a degree.

The carriage is pointed in azimuth by means of a chain lying around the traversing circle, and fastened at one end by a shackle to a lug screwed into one end of the traversing circle. The other end of the chain is attached to another lug by means of a long screw bolt with a nut and check nut. By means of this screw bolt any slack in the chain may be taken up. Between the ends, this chain is carried over a sprocket wheel by two direction pulleys suspended by brackets from the underside of the traversing-wheel transom, so that any motion of the sprocket wheel causes the carriage to move in azimuth. The sprocket wheel is keyed to a longitudinal shaft which also carries in rear a bronze worm wheel.

This worm wheel is actuated by a steel worm, keyed to the traversing-worm shaft, which is supported by the traversing-gear bracket projecting upward from the traversing-wheel transom to which it is bolted. This bracket also supports the sprocket-wheel shaft and forms a box for the worm, which has ball thrust bearings. The worm shaft is also supported in bronze-bushed bearings in projections on the rear end of the chassis. Traversing cranks, with arms 13 inches long, and with loose brass sleeves, are placed on the squared ends of the traversing-worm shaft. For the protection of the traversing worm and worm wheel a dust guard is fastened to the traversing-gear bracket.

Bronze gears are keyed to the traversing-worm shaft just outside the chassis rails, and these are engaged by smaller bronze gears, keyed to a parallel shaft above the traversing-worm shaft, working in bearings cast in the chassis. The outside ends are squared so that the traversing cranks can be detached from the traversing-worm shaft and applied to the shorter shafts when more power is required for retracting the gun from battery by hand. For this purpose double-sheaved pulleys are attached to the upper ends of the gun levers and to brackets cast on the chassis, and two windlass drums are keyed to the traversing-worm shaft—one on each side and close to the worm box. Two lengths of 75 feet of 3-inch manila rope with hoops spliced in one end are provided. After reeving the rope about the pulleys, several turns are taken around the drums, so that any motion of the drums is communicated to the ropes. In hauling down care should be exercised that *each rope is under equal tension*. The ropes should be vibrated slightly, and if unequally loaded adjustment should be made about the drums. When the hook in the rope is attached to the eye on the gun levers, *it should be noted that there are no kinks in the ropes, and in wind-*



*ing up the slack that the rope is guided to the sheaves without a kink, and coils lie snugly on the drums.*

In order that the carriage may not be moved in azimuth while the gun is being retracted, a simple arrangement is provided for throwing the worm wheel in and out of gear. When out of gear, the rotation of the worm wheel does not cause a rotation of its shaft, and consequently the rotation of the drums on the worm shaft imparts no motion to the sprocket wheel. The retracting fall is not attached to the carriage except for drill purposes.

The sprocket-wheel shaft is hollow, and the clamp crank shaft passes through it and the traversing-clamp crank attached to the rear end which projects beyond the sprocket-wheel shaft. This shaft, through two pairs of miter gears, actuates the traversing-clamp screw, the right and left handed threads of which operate the two jaws of the traversing clamps. The clamps are suspended from hinge brackets on the underside of the traversing-wheel transom, and hang on opposite sides of the traversing circle. Turning the screw in one direction closes the jaws until they bear against the traversing circle and serve as friction clamps to prevent any possible movement of the carriage during firing.

Pointing in elevation is effected by means of bronze elevating racks working in guides bolted to the inner faces of the chassis rails. Stop plates are bolted across the elevating-rack guides, and there are three holes in the racks in which pins can be inserted to limit the depression of the gun to 0,  $2\frac{1}{2}$ , or 5 degrees, depending on the parapet over which the gun is to be fired.

Two elevating-rack pinions, keyed to two pinion shafts passing through bronze-bushed bearings cast in the chassis, engage the elevating racks. Two elevating-spur wheels of cast steel are keyed to the outside ends of these shafts and have circular brass plates fastened by screws to their outside faces, to be graduated at the place of manufacture after the gun is mounted on the carriage. These brass circles are graduated to minutes, and elevation pointers, conveniently placed, are attached to the chassis. The least reading is one minute. Parallel to these short shafts is the elevating through shaft passing through bronze-bushed bearings last on the chassis. Two bronze spur pinions engaging in the large spur wheels are keyed to this shaft, which also carries at its ends the two elevating handwheels. On the left side of the carriage, between the spur pinion and the elevating handwheel, a friction-clamp pulley is keyed to the same shaft, and is so arranged that any desired amount of friction can be obtained. *The nuts for adjusting the tension of the spring should be set up just sufficiently to prevent the gearing from running down when left to itself. The*

*friction is released by means of a cam and lever.* By this means any firing strains dangerous to the elevating mechanism are avoided.

The elevating racks have journals cast on them, to which the elevating arms are attached. These arms are made of forged steel and are 9 feet 2 inches long, measured from center to center of journal bearings. They are united and supported near their middle points by a cast-steel truss about  $4\frac{1}{2}$  feet long. The other ends of the elevating arms are attached to journals on the cast-steel elevating band on the gun.

While theory requires, in order that the gun shall always return to the same angle for loading, whatever may be the firing angle, that the elevating rack shall be circular and struck with a radius equal to the length of the elevating arms, using the center of the journal on the elevating band when the gun is in the loading position as a center, yet certain difficulties, as well as expense in manufacture, have made it more convenient to make the racks straight. These are so placed, however, as to cause only a slight variation in the loading angle, which is about 7 degrees. On account of the character of the motion, the distance between the degree marks on the elevation scale is not constant, requiring that the scale be graduated after the gun is mounted.

The ammunition is served to the gun on an ammunition truck. The projectile tray is so arranged that the projectile can be easily raised to the proper height for loading, and may also be given practically the same angle that the gun has in the loading position.

A sight standard is placed above the rear part of the right chassis. The bracket attaching it to the chassis also serves to support the end of the right piston rod.

A sighting platform is built, in rear of the standard, on brackets bolted to the chassis, and it is reached by means of an iron ladder attached to it in the rear.

Another sighting platform is attached to the top carriage just above the right recoil cylinder, to be used when a sight is placed on the right trunnion. This platform is reached by means of steps on the right chassis, and a handrail attached to the top carriage is also provided. There are plates on the carriage indicating the direction of motion of the elevating handwheels in elevating or depressing the gun, and that of the cranks for traversing.

The carriage permits of the gun being traversed through 120 degrees and elevated from  $-5$  to  $+12$  degrees.

*Oil of specific gravity of about 0.85* should be used for filling the cylinders. With this oil the pressure in the cylinders is about 800 pounds per square inch. A denser oil would cause a higher pressure in the cylinders and therefore shorten the recoil slightly. The ca-

capacity of the recoil cylinders is approximately 20 gallons. Drainage holes are drilled in all pockets; and all axles, trunnions, and sliding bearing surfaces are provided with oil holes, and when practicable with compression grease cups, the holes and cups having screw covers easily removed.

The action of the carriage is as follows:

Upon firing the piece, the gun-lever axle moves to the rear, carrying the top carriage with it. The lower end of the levers moves vertically upward, being constrained by the crosshead guides. The trunnions of the gun move downward and to the rear in the arc of an ellipse. The energy of recoil is absorbed partly by raising the counterweight, but principally by the resistance of the recoil cylinders, and when the gun comes to rest it has the proper loading angle. After loading, the pawls are tripped, and the greater moment of the counterweight enables it to raise the gun to the firing position.

If from any cause the gun should stop short of this position, fulcrum pins inserted in each chassis, near the forward end of the top carriage, serve as points of support for pinching levers held vertically and engaging the ratchets on the undersides of the top-carriage clips for heaving the top carriage forward.

An elevating band, one pair of shot tongs for each trolley provided by the Engineer Department, three ammunition trucks, and the necessary tools and implements are furnished with each carriage. The tripping bars are placed on hooks on the sides of the carriage, and the tools are neatly packed in a box marked with the number of the carriage.

The amount of lead counterweight furnished with each carriage is approximately 33,300 pounds, and is designed to be a few thousand pounds in excess of that required to raise the gun to the firing position under normal conditions.

*The recoil cylinders should be completely filled with oil for all charges, unless specific instructions to the contrary are received. The proper amount of counterweight is that which will raise the gun to the firing position without a shock to the buffers or stops. This should be determined by careful trial, and in no case should more be added to shorten the recoil.*

Compression grease cups are provided for the bearings of the gun trunnions, the gun-lever axles, and the suspension-rod shaft bearings. Their use permits the application of pressure to the lubricant and insures its presence between the bearing surfaces.

Sight retainers have been provided for securing the telescopic sight to the sight holder in order that it may be left in the holder during firing.

When traversing or retracting the gun, the crank handles should be placed on the shafts 180 degrees apart.

**SAFETY LANYARD ATTACHMENT.**—To prevent the firing of the piece by a pull, accidental or otherwise, upon the lanyard before the gun has risen to the firing position, the lanyard is made in two parts, one from the primer to a ring attached to the safety device, the other from that ring to the loading platform of the emplacement where it is to be pulled by a cannoneer. To the ring to which these two lanyards are attached is fastened a wire cord which passes around and is wound upon a reel carried in a housing attached to the rear face of the elevating band of the gun. A spiral spring causes this reel to rotate so as to wind up the cord and keep it wound up unless it is pulled out against the action of the spring. This unwinding is prevented by the engagement, in ratchet notches on the reel, of a spring-actuated pawl, which is automatically released when the gun has reached the firing position by a cam attached to the rear face of the upper end of the elevating arm, when the gun has reached the firing position; that is, when it has been raised to such a height that the projectile will clear the parapet. As, before this, the reel can not turn, the wire cord can not unwind, and the short lanyard can not be pulled to the rear sufficiently to bring any pull whatever on the primer wire. The long lanyard having no connection with the short one except through the ring on the wire cord coming from the reel, a pull upon this long lanyard does not affect the short lanyard or the primer until the pawl is released and the wire cord is pulled out against the resistance of the spring, at which time it is safe to fire.

#### TO ASSEMBLE THE CARRIAGE.

This requires the machines and implements for mechanical maneuvers usually found at forts.

*It may be stated generally that in assembling carriages no parts should be directly struck with a steel hammer, and that copper drifts or copper or lead hammers should be used. When two bearing surfaces are brought together, it is especially necessary that both parts should be absolutely clean, smooth, and well lubricated.*

The size and weight of the carriage permit it to be transported by rail almost assembled, so that when it arrives at its destination only a few of the large parts have to be put in place, namely: Elevating arms with truss, sight standard with platform and ladder, gun levers with axle, crosshead and suspension rods assembled, counterweight, base ring, traversing circle, traversing rollers, traversing clamp, traversing chain, dust guard, clip, and elevating band. These, with a few minor parts and implements, are boxed or otherwise well secured for shipment.

The following description refers more particularly to the order in which the parts are to be put together than to an enumeration of the details of the operation:

The base ring is moved to its position over the platform bolts by means of skids and rollers. When the holes in the base ring are directly over the corresponding bolts, lower, by means of the jacks or the shears, until the ring is on the platform, with the bolts as nearly central in the holes as possible. Hold the bolts in this central position by means of sheet-copper wedges, curved to fit around the bolts.

On each side of every platform bolt there should be an iron wedge 8 inches long, 4 inches wide, and approximately  $\frac{1}{4}$  inch thick at the larger end, resting on an iron plate 8 inches long, 4 inches wide, and  $\frac{1}{8}$  inch thick. These wedges and plates serve to give the base ring proper support on the already well-set concrete and permit the grouting to become well set without deformation while the remaining parts of the carriage are being assembled. In the more recent carriages these wedges and plates have been replaced by leveling screws and thrust plates. After the grouting under the base ring has set firmly, these screws should be unscrewed slightly to prevent their being strained in firing.

*A sensitive machinist's level and an accurate steel straightedge should be used in leveling all parts.* The greatest care must be exercised in using the "level" and "straightedge" that the middle of the level is equidistant from the points of contact of the straightedge with the surfaces being leveled, and that these points of contact on the straightedge are equidistant from either end. The level should always be reversed and the mean considered the true reading.

The threads of the platform bolts should be carefully examined to see that they have not burred in the operation of lowering, and to see that they are free from rust. After they have been put in good order, thoroughly oil the threads of both nuts and bolts before screwing on the nuts. In screwing down the nuts on the platform bolts take up on each a little at a time, so that no part of the base ring will be strained. After the base ring is properly leveled and fixed in place, pour under it a grouting of neat Portland cement.

Place the segments of the traversing circle in their positions over the platform bolts and join them together with the joint plates. Then lower as nearly horizontally as possible and with a bearing under each segment so that any part may not be strained until the circle rests on the wedges or leveling screws before described. Clean the lower roller path and pintle surfaces with kerosene and fine emery cloth if necessary, and also the traveling circle, and supply the templet or leveling tool for setting the latter. *Use an accurate machinist's level on top of the leveling tool, and, in addition, level*

*the segments by means of a straightedge and screw down the platform bolt nuts to a good bearing.* Be careful to have the joints close together and at the same height. Do not grout the traversing circle until the carriage has been mounted, as some little change in height may be necessary to give the traversing roller a better bearing.

*As the working of the carriage depends in a great measure on the proper setting of these two parts, too great accuracy can not be enjoined for these operations.*

Before the main part of the carriage is mounted, clean the rollers and distance ring and place them on the lower roller path. The rollers should be run around several times by hand to see that they work freely and that they do not bind against the distance rings. If there is any binding it should be remedied before proceeding.

The main part of the carriage should now be moved to its approximate position on a cradle. In order to free the cradle, lift the front end of the carriage by means of the shears and jack up the rear end. Then block up well to avoid accidents. Lower the carriage in front and rear until the racer is nearly down to the base ring. If the carriage now needs to be removed to enable the racer to slip over the pintle in the base ring, place iron rails on the base ring and plate iron on the blocking in rear, well lubricated, and lower the carriage until it rests on these. Then by means of the jacks the carriage can be moved a sufficient distance. Take a new lift with the shears, and from this point be careful to lower the front and rear of the carriage together, so that the pintle surfaces will not be jammed. Assemble the chain-pulley bracket and pulleys and the traversing chain at this time so that the carriage can be traversed to see that it works properly. If the traversing circle has been set correctly, all of the traversing wheels and traversing rollers should bear in all positions of the carriage. If this is not the case and the base ring is absolutely level, some change must be made in the height of the traversing circle. The dust guard should be assembled as soon as possible to protect the rollers and roller paths. The upper roller path must be cleaned before it is lowered onto the rollers.

Now place iron rails or blocking on the racer, and on these place the bottom plate of the counterweight. The rails or blocking should be near the diametral rib, to give room for screwing up the nuts on the suspension rod.

To enable the pawls to engage well, the height of the rails or blocking should not exceed 8 inches. Build up the counterweight on the bottom plate, arranging the holes vertically above each other and in a line, so that the suspension rods will pass through them easily when the crosshead pieces are engaged over the guides. The

largest counterweight weighs approximately 6,550 pounds, four smaller pieces each weigh 5,475 pounds, two each weigh 1,000 pounds, and two weigh approximately 770 pounds apiece.

The gun levers can be raised high enough by means of the shears or a garrison gin, and then lowered carefully, allowing the suspension rods to go through the counterweight.

Screw up the suspension rod nuts evenly and then the check nuts, and allow the pawls to engage in the ratchet on the crosshead pieces. Do not allow the pawls to hold up the counterweight until the gun is mounted on the arms; hence, the rails or blocking should not be removed until this is accomplished.

It is of great importance that each suspension rod should bear but half of the weight, and the nuts must be carefully adjusted to bring this about.

The gun levers may now be still further lowered and the top carriage run back until the gun-lever axle is seated in its bed, having these parts well cleaned and oiled and free from burrs, then bolt on the caps.

The elevating band can be placed on the gun before it is mounted. The band is properly placed when the *centers of its journals* are  $84\frac{1}{2}$  inches from the centers of the trunnions of the gun and in the same plane with them. *It would be well to put ground emery and oil between the band and gun to make the band grip better.* The distances between the centers of journals and trunnions should be measured on each side. After the band is properly placed tighten up the bolt through the lugs, then drill into the gun  $\frac{1}{8}$  inch on each side for the points of the set screws, and firmly set up the screws.

The gun can be raised by means of the shears, and when high enough one of the guys can be loosened to allow the gun to swing over the axis of the carriage.

Before lowering the gun into its trunnion beds see that the burrs have all been removed from the trunnions and that they are clean and well lubricated. Now bolt on the cap-squares. The gun may also be mounted from the rear by means of blocking, but this is rather a tedious operation.

The elevating handwheels should now be placed on their shafts, if not already there.

In order to assemble the elevating arms separate one arm from the truss. The two parts can then be easily assembled by means of a fall. The sight standard can be screwed into its bracket and the ladder and platform placed in rear.

Take the traversing clamp jaw having an offset and attach it to the hinge bracket, bolting the latter to the traversing wheel transom, so that the jaw hangs on the inside of the traversing circle. Push

the vertical traversing-clamp shaft down through the top bracket and also through the lower bracket, which should be free from the transom for the present, and put on both miters. Screw the miter end of the clamp screw through the inside jaw and put on its miter.

When the vertical shaft is in its proper position the miter on the screw should properly engage in the lower miter on the vertical shaft. When the jaw is hard against the traversing circle, note the position of the screw. The pitch of the right and left hand threads is six per inch, and, knowing the distance by which the jaws are separated when they both bear against the traversing circle, the number of turns that the screw must make in the outside jaw can be determined.

When the screw is properly entered in the outside jaw, bolt its hinge bracket and the lower bracket for the vertical shaft in place. Push the Tobin bronze shaft through the sprocket-wheel shaft from the rear and assemble the miter and nut.

Next see that the stuffing boxes are properly packed.

*No more force should be used on the spanner wrench than that of two men, and generally one man is sufficient. The addition of a pipe to the end of the spanner wrench should not be permitted.*

Now that the carriage is entirely assembled, the cylinders should be filled with oil, removing for this purpose all the filling plugs. The two cylinders together hold, when completely filled, approximately 20 gallons. After all the bearing parts have been thoroughly cleaned and well lubricated, release the blocking under the counterweight by means of the pawl levers. The pawls should then be tripped and the gun allowed to rise into the firing position, to see that everything is working properly. The pieces in the top layer of counterweight should be added gradually until the proper amount of counterweight necessary to raise the gun to the firing position, with the least possible shock to the counter-recoil stops, has been determined, by allowing the gun to rise several times, each time with an increase of counterweight. *The retraction fall should be detached after the gun is hauled down to the loading position and before it is allowed to rise again to the firing position.* Note that the retracting ropes are so adjusted that, when in hauling down the levers are nearly to the buffers, the pawls click together. *Do not attempt to retract the top carriage until the gun levers touch the buffers. The proper position of the gun for loading is with the gun levers  $1\frac{1}{2}$  inches above the buffers.* The carriage should also be traversed to its extreme positions against the azimuth stops and the gun then hauled down to see that nothing will interfere with its recoil in these positions.

Before using the carriage, in addition to having all bearing parts free from rust and lubricated, the recesses for the recoil rollers should be cleaned out and the rollers should be made dry. Otherwise, espe-



cially in sandy places, small particles raised by the blast are liable to adhere to the rollers and take up all the clearance which the top-carriage clips have on the underside of the chassis rails.

After the carriage has been completely assembled and the gun mounted, the following points should be noted, viz:

1. See that all the traversing rollers are bearing, and also that the traversing wheels bear when the carriage is traversed throughout the entire arc.
2. Examine and clean out all oil holes.
3. See that the recoil rollers turn freely by hand, and that the recesses are clean.
4. See that each suspension rod bears its full share of the counter-weight.
5. See that the pawls and pawl safety latch operate properly, and that the gun can be moved from battery by means of the pawl levers.
6. See that there is not a hard bearing between the rim base of the gun and the gun levers.
7. See that the elevating arms and band are properly assembled.
8. See that the chassis rails and crosshead guides have not been burred.
9. See that the traversing chain is not too slack.
10. See that the dust guard does not bear against the distance ring.
11. See that the counter-recoil buffers act properly when the gun rises to the firing position.
12. See that the elevating-rack journals stand at the same height on each side of the carriage.
13. See that the piston rods are parallel to the tops of the chassis rails, and also to the inside edges; that they are hard against their seats in front, and that the nuts are tight.
14. See that the followers of the cylinder heads are tight, and that those in rear do not bear against the brackets when the gun is in the loading position.
15. See that the pawl stops permit the pawls to engage the racks properly.
16. See that the traversing chain clears the holes in the traversing-wheel transom, and also the direction-pulley brackets.
17. See that the graduations of the azimuth circle are correct.
18. Verify the graduations for elevation.
19. See that all grease cups are properly filled and set up sufficiently hard to insure a flow of the lubricant.
20. See that the stops are properly placed to limit the motion in elevation and azimuth.

**NOTE.**—Unless the rollers are unusually long, it will be advantageous to use a cradle as narrow as possible. This will prevent the splitting of the rollers near the ends and permit them to be more easily cut. The carriage and gun may be taken over the parapet. This requires a cribbing of blocks from the parapet to the emplacement. After the carriage is in place this same cribbing, in addition to the blocking on the chassis rails, will serve to mount the gun. After it is moved to a position over the trunnion beds it can be lowered by means of jacks.

## CARE OF CARRIAGE.

**GENERAL INSTRUCTIONS.**—Carriages should be traversed from time to time throughout their entire allowed movement. They should not be allowed to stand for long periods at a particular azimuth, as this might cause uneven settling of the platform.

The habitual position of guns on disappearing carriages is "from battery," but at intervals the gun should be allowed to rise to the firing position and be elevated and depressed within the limits of the stops.

*The action of the pawls should be tested before all firings to see that their action is not sluggish, due to weak springs or lack of lubrication.*

*It is required that all parts of carriages be kept free from rust at all times.* If this be allowed to accumulate, its removal from bearing parts, and especially piston rods, requires particular attention in order that clearances may not be unduly increased. The use of sandpaper or coarse emery cloth for this purpose is forbidden. Emery cloth No. 1 should be used, the rust being softened, if necessary, by kerosene.

If any leakage occurs from the hydraulic recoil system, it should be immediately remedied, calling, if necessary, upon the district armament officer for the services of skilled labor.

The repacking of stuffing boxes may be done, when necessary, by trained enlisted men under the supervision of an officer, but will preferably be done by skilled labor.

Before removing a cylinder head containing a stuffing box, or drawing a piston rod through a stuffing box, the pressure of the packing on the rod should be released by unscrewing the follower several turns.

The vulcanized fiber or copper gaskets between cylinders and their heads should be in good condition, and consequently should be replaced whenever necessary in order to prevent leakage.

Recoil cylinders should be emptied at least every three months and thoroughly cleaned every six months.

**CLEANING RECOIL CYLINDERS.**—For this cleaning a plumber's hand force pump will be supplied to each coast artillery post, with about 10 feet of suction hose and 15 feet of discharge tube.

In cleaning, the following order of operations may be followed:

(a) Run gun into battery and remove oil from hydraulic recoil system.

(b) Retract gun until pistons are in the middle of the cylinders; then slack away until the pawls engage in the ratchet teeth on the

crosshead; observe that the pawls are properly engaged in the ratchet teeth, and that the pistons are not under the filling holes.

(c) Remove the piston-rod brackets from the rear ends of the chassis rails. Take off the two nuts on the front end of each piston rod, remove the rear cylinder head from each cylinder, and carefully remove the rods rearward out of the cylinders. Before removing any part it should be marked so as to insure its being reassembled in its correct position.

(d) Thoroughly clean each cylinder from both ends with kerosene oil forced in with a hand pump, then wipe dry with clean cotton waste. Clean the piston rods and stuffing boxes. The equalizing and connecting pipes should be thoroughly cleaned by forcing kerosene oil into them with the pump, permitting it to run out through the emptying hole. The throttling recoil and buffer-valve stems should be removed from the body, to facilitate this work.

(e) After the removal or evaporation of all kerosene oil, reassemble the parts and refill the cylinders with hydroline oil, after which close the valves to their normal settings, carefully inspect all parts dismounted, and complete the retraction of the piece. It should not be tripped before again removing the oil plugs and adding any oil needed.

**REMOVING PACKING FROM STUFFING BOXES (USING EXTRACTOR FURNISHED BY THE ORDNANCE DEPARTMENT.)**—Close the extractor around the piston rod and insert the locking pin. Turn the extractor to the left, with pressure on the packing, until the needles are firmly engaged in the packing. Draw the packing out, turning slowly to the left. In the case of a box with interior thread, if the ring is tight, it should be unscrewed and not stripped out by the thread, because unless unscrewed it would catch upon and be injured by the thread.

Extractor bars are provided to be used for starting the packing from its seat by inserting the toes of the bars in the rack teeth and prying over the edge of the box, being careful not to injure the thread.

**REPACKING STUFFING BOXES.**—Examine the old packing and discard all unfit for use. If any of the old packing is used, it should be put in after the new.

To repack, put on the piston rod one ring of 0.625-inch Garlock's "waterproof hydraulic" packing and force it well to the bottom of the stuffing box by a wooden stick and mallet. Treat each layer of packing in a similar manner, being careful to break the joints, until six rings of packing have been inserted. Place the halves of the gland on the follower, enter them together in the box, and screw up the follower, being careful to note that the halves of the gland do not bind on the screw threads.

*No more force shall be used on the spanner wrench than that of two men, and generally that of one man is sufficient. The addition of a pipe to the end of the spanner wrench should not be permitted.*

When the box is properly filled and the follower tightened, there should not be more than 1 inch of space between the flange of the follower and the piece into which the follower is screwed. The follower should be tightened from time to time. If the follower is screwed into the stuffing box too tightly, an unnecessary amount of friction will be produced on the piston rod. When the follower is screwed in until the flange strikes the box, another ring of packing should be inserted.

It is to be expected that a slight amount of oil will soak through and drip from boxes of carriages when not in use. Also when tightening the followers a slight amount of oil will squeeze out of the saturated packing. This oil should be caught and not allowed to render the carriage unsightly.

**FILLING RECOIL CYLINDERS.**—*In filling, all the filling plugs should be removed from each cylinder so as to insure the latter being entirely filled.*

After the cylinders have been completely filled, one gallon of oil should be removed from the system in order that voids may be formed in each cylinder to permit expansion of the oil. After the position of the filling plug in each cylinder has been moved forward, the withdrawal of the oil from the system will not be necessary, since when the cylinders have been filled as full as the new position of the filling holes will permit, the required void for expansion of the oil will be left.

**SERVICE CONDITION (LUBRICATION, ETC.).**—When the carriage is to be kept in readiness for service, and is in daily or frequent use, all bearing parts must be kept thoroughly cleaned and lubricated. Especial attention should be given to the lubricating of trunnion beds, rollers, pintle surfaces, shaft bearings, and sliding surfaces; gun-lever axle beds, crosshead pins, elevating screw, elevating-band trunnions, crosshead guides, and the elevating, traversing, tripping, and retracting mechanisms, including the teeth of all gears, and the crosshead pawls.

*The above parts should be lubricated at frequent intervals, whether the carriage is maneuvered or not. When carriages are in use for daily drills, a thorough lubrication twice each week should be sufficient for all but the most severely used parts.*

Proper lubricating and cleaning of the traversing rollers and their paths are essential to free working of the carriage. The dust guards should be removed to clean the upper roller paths and oil the rollers; the pintle surface is oiled through from oil holes leading through the top surface of the racer near the ends of the chassis rails. It will occasionally be necessary to examine the roller bearings to see

that the dust guards are in proper place and that the rollers are themselves clean. If they be found dirty they may be flushed with kerosene oil, but care must be taken to fill the bearings with engine oil after the kerosene has drained away. If the rollers have rusted, the bearings must be taken out, the rollers cleaned, and the bearings reinserted.

**RECOIL CYLINDERS.**—Experience has shown that recoil cylinders should not remain empty, as in that case the interior walls soon become rusted.

**OIL HOLES.**—Oil holes should be cleaned out frequently to keep them free from sand and grit, and should habitually be kept closed by the screw plugs provided, except when in the act of oiling.

*Before removing the plug from any oil hole carefully wipe off any dirt or grit near the opening that might be carried into the bearing with the oil.*

**COMPRESSION GREASE CUPS.**—Where compression grease cups are provided, similar precautions against dirt or grit must be observed. When adding grease to these cups, do not fill them completely, but fill only to the bevel at the top of the cup; if too full, the leather packing will become inverted and will not act effectively. In putting on the cap see that the leather packing enters the cup without being caught or bent by the edge of the cup.

Screw the cap down on the cup until the spring rod projects about 0.25 inch above the top of the cap. The cap should be screwed down from day to day as required to maintain about this projection for the rod. When the cap is screwed nearly home, the cup should be refilled.

For further information regarding paints, oils, cleaning materials, and methods of using these, see Ordnance Department Pamphlet, Form No. 1869.

LIST OF ARTICLES PACKED IN THE ARMAMENT CHEST FOR 8-INCH GUNS, MODELS OF 1888, 1888 MI, AND 1888 MII.

Bar screw driver for breech-plate screws.	Ring for lifting breech plate.
Bar screw drivers for breech-mechanism screws, 3.	Graduated sight bar.
Tool for unscrewing housing of crank catch.	Handwheel for sight bracket.
Extension pipe handle.	Gunner's punch.
Hook for lifting obturator.	Gunner's reamer.
Obturator nut wrench.	Gunner's gimlet.
Obturator nut washer.	Gunner's pouch.
Locking nut washer.	Gunner's sleeves, 1 pair.
Primer key.	Gunner's lanyard.
Pin punch.	Loading tray.
Tit wrench.	Metal scraper.
Pressure plug wrench.	Silk wipers, 1 dozen.
	Twine, assorted, 4 balls.
	Copper wire, No. 12, 2 pounds.
	Copper wire, No. 16, 2 pounds.

Emery cloth, No. 00, 1 quire.  
 Sandpaper, No. 00, 1 quire.  
 Wagon sponges, 3.  
 Vaseline, 1 gallon.  
 Sperm oil, 1 gallon.  
 Sperm-oil can.  
 Vaseline can.  
 Water buckets, 2.  
 File, flat, dead smooth.  
 File, round, second cut.

File, half round, smooth.  
 Vaseline brush.  
 Copper hammer.  
 Boiler maker's hammer.  
 Hand mallet.  
 Long-handled mallet.  
 Oiler.  
 Cutting pliers.  
 Screw wrench, 15-inch.

LIST OF ARTICLES PACKED IN THE IMPLEMENT BOX FOR 8-INCH DISAPPEARING  
 CARRIAGE, L. F., MODEL OF 1894.

2 tripping bars.	1 double wrench for 1½-inch and 1½-inch nuts.
2 retracting ropes.	1 double wrench for 1½-inch and 1½-inch nuts.
2 extractors for stuffing-box washers.	1 single wrench for 2-inch nut.
3 spanner wrenches for stuffing boxes.	1 ¾-inch eyebolt.
2 wrenches for suspension-rod nuts.	1 wrench for pipe connection.
2 wrenches for piston-rod nuts.	1 oil can, capacity 1 quart.
1 wrench for cylinder head.	2 oil cans, capacity each half a pint.
1 double wrench for ¾-inch and ¾-inch nuts.	2 counterweight hooks.
1 double wrench for ¾-inch and ¾-inch nuts.	
1 double wrench for ½-inch and 1-inch nuts.	

LIST OF IMPLEMENTS FURNISHED FOR 8-INCH GUNS, MODELS OF 1888, 1888 MI,  
 AND 1888 MII.

1 rammer and staff.	1 sponge cover, bore.
1 rammer and staff, short.	1 sponge cover, chamber.
1 sponge and staff, bore.	1 slush brush with handles to connect with sponge staff.
1 sponge and staff, chamber.	1 steel scraper and socket to fit sponge staff.
1 sponge and rammer prop.	
1 breech cover.	
1 combined tomplon and muzzle cover.	

GASKETS AND PACKING.

1 set gaskets for carriage.  
 22 rings Garlock's waterproof hydraulic packing, 0.75 square and 3.5 inside diameter.

*Approximate weights of the principal parts of the 8-inch disappearing carriage, L. F., model of 1894.*

Name.	Weight.
	<i>Pounds.</i>
Chassis, racer, top carriage, traversing wheel, transom, etc.....	34, 685
Base ring, with traversing rollers and distance rings.....	7, 515
Traversing circle (4 segments).....	6, 075
Traversing chain, with pulley brackets, pulleys, bolts, and washers.....	318
Gun-lever arms, with axle, crosshead, and suspension rods.....	7, 500
Elevating arms, with truss, boxes, and caps.....	888
Bottom plate for counterweight.....	875
Lead counterweight.....	34, 000
Joint plates for traversing circle.....	422
Other small parts, with bolts, implements, etc.....	1, 352
<b>Total.....</b>	<b>93, 630</b>

*Names of the parts of the 8-inch disappearing carriage, L. F., model of 1894, with their location, and the material of which they are made.*

Names of parts.	Location.	Material.	Number.	Diameter or	Length.	Nuts.	Remarks.
				width.			
				In.	In.		
Adjusting screw	Telescopic sight holder	Bronze	1				
Azimuth circle	On traversing circle	Brass	1				
Axle keys	Traversing wheel axles	Forged steel	4	2½	6		
Base ring	On platform	Gun iron	1	105			
Ball washers	On traversing worm shaft	Steel	2				Each with 2 washers and 31 ¼-inch hardened steel balls.
Bearing, lower	Vertical shaft of traversing clamp.	Cast iron	1	2½	7		
Bolts	Equalizing pipe straps	Wrought iron	2	½	8		
Do	Top carriage caps	do	4	1½	6½		
Do	Chassis to racer	do	30	1½	3½		
Do	Chassis to traversing wheel transom	do	22	1½	3½		
Do	do	do	4	1½	3		
Do	Vertical liners on chassis	do	10	½	2		
Do	Chassis to transoms	do	46	1½	2½		
Do	Elevating rack guides to chassis	do	32	1	3		
Do	Roller dust guard to racer	do	33	½	8		
Do	Joint plates to roller dust guard	do	24	½	8		
Do	Traverse-wheel axle keys	do	8	2	1½		
Do	Traverse-gear bracket	do	6	1	2½		
Do	Traverse-clamp hinge bracket	do	4	1	4½		
Do	Traverse-clamp vertical shaft bearing	do	2	8	1½		
Do	Handle to gun lever	do	2	8	1½		
Do	Elevating arms to truss	do	2	1½	3½		
Do	do	do	4	1½	4		
Do	Stop-plate to elevating-rack guides	do	6	1½	2½		
Do	Elevating-rack trunnion	do	2	1½	2		
Do	Elevating clamp	do	1	1	16	2	
Do	Chain-pulley brackets	do	2	1	1½		
Do	Crosshead liners	do	4	8	18		
Do	Elevating band	do	1	2	6	1	
Do	Piston-rod brackets	do	4	2	3		
Do	Piston-rod bracket and sight platform	do	2	2	3½		
Do	Sighting platform and ladder braces	do	2	8	2½	2	Countersunk head.
Do	Trunnion-sight platform	do	2	8	1½	2	Do.
Do	Chassis-platform braces	do	2	1½	1½		
Do	Ladder brace	do	2	11	11		
Do	Sight standard caps	do	4	2½	4		
Do	Trunnion-sight platform	do	2	3	2		
Do	do	do	2	11	11		
Do	Joint plates, trav. circle	do	24	1	2½		
Do	Throttling bars	Forged steel	32	2	2½		
Do	do	do	4	2	2½		
Do	Elevation pointer	Wrought iron	2	2	2		
Do	Hand rail on cylinder	do	4	1½	13		
Do	Racer clip	do	4	1½	3		
Do	Handle on gun lever	do	2	18	18		
Bracket, piston rod	On rear of right chassis	Cast steel	1	8½	19		
Do	On rear of left chassis	Cast iron	1	8½	18		
Buffer, counter-recoil.	Recoil cylinders	Special bronze	2				
Buffer caps	Buffers, rear of chassis	Wrought iron	2	6	12½		
Buffer plates	do	do	6	6	12½		
Buffer cushions	do	Rubber	8	5½	12		
Buffer bolts	do	Wrought iron	4	5	11½	8	
Bushings	Top carriage, gun-lever axle beds	Bronze, No. 1.	2				4 halves.
Do	Upper end gun levers	do	2				Do.
Do	Lower end gun levers	do	2				Forced in place.
Do	In hauling down sheaves	do	8				
Cam	Elevating clamp	Steel	1	2.78	2½		
Cap	Telescopic sight holder	do	1				
Cap-squares	Gun levers	Forged steel, No. 3.	2	6	30		



*Names of the parts of the 8-inch disappearing carriage, L. F., model of 1894, with their location, and the material of which they are made—Continued.*

Names of parts.	Location.	Material.	Number.	Diameter or width.	Length.	Nuts.	Remarks.
Chassis, right-hand.	On racer .....	Cast steel, No. 1.	1	<i>In.</i> 77½	<i>In.</i> 0	...	
Chassis, left-hand.	do .....	do .....	1	77½	170	...	
Chain-pulley brackets.	Under rear of traverse wheel bracket.	Cast steel.	2			...	
Chain-pulley axles.	In pulley brackets .....	Forged steel.	2			...	With split pins.
Chain pulleys.	do .....	Wrought iron.	2	3½		...	Bronze bushed.
Clamp crank shaft.	Traversing gear bracket.	Tobin bronze.	1	2	34½	1	1 split pin.
Clamp vertical shaft.	do .....	Steel	1	1	24½	...	
Cover .....	Sight standard .....	Wrought iron.	1			...	
Counter weight hooks.	With carriage .....	do .....	2			...	
Counter weight bottom plate.	Suspended from cross-head shaft.	Cast iron.	1	46.5	6	...	
Counterweights.	do .....	Lead.	4	46.5	8	...	
do.	do .....	do.	1	46.5	11	...	
do.	do .....	do.	2		3	...	1 layer in 2 halves.
Counterweights.	Suspended from cross-head shaft.	Lead.	2		4	...	1 layer in 2 halves.
Do.	do .....	do.	18			...	Top layer.
Crank .....	Telescopic sight holder.	Steel.	1			...	
Crank fastening.	Traversing clamp crank.	do.	2	125		...	Twisted coil chain .375 by 2.5 split pin.
Crosshead pieces.	On chassis vertical guides.	Cast steel.	2	6½	30	...	1 right-hand, 1 left-hand.
Crosshead liners.	In crosshead pieces.	Bronze.	10		30	...	
Crosshead pawl latches.	Safety tripping device.	Steel.	2			...	
Cylinder head extractor.	Cylinder head.	Steel.	2			...	
Distance ring (inner).	Traverse rollers.	Wrought iron.	1	74½	4½	...	
Distance ring (outer).	do .....	do.	1	94	4½	...	
Distance rings.	Roller bushings, in traverse wheels.	Bronze.	8	5½	½	...	
Dog .....	Top carriage.	do.	1			...	
Dowel pin.	Elevation bracket.	Steel.	1			...	
Dowel pins.	Safety tripping device.	do.	4	375	1.2	...	
Dust guard.	Traversing wheel.	Sheet steel, No. 20 B. W. G.	1			...	
Do.	Worm wheel.	Sheet steel.	1			...	
Elevating arm.	On rear of gun.	Forged steel.	2			...	1 right, 1 left.
Elevating spur wheels.	Elevating shaft.	Cast steel.	2	24½	3½	...	72 teeth, and graduated plate screwed on.
Elevating spur pinions.	Outer ends, elevating rack pinion shaft.	Bronze.	2	5½	3	...	15 teeth.
Elevating rack guides.	Inside chassis.	Gun iron.	4	5½	62	...	
Elevating racks.	do .....	Bronze, No. 3.	2	9	34½	...	1 right-hand, 1 left-hand.
Elevating rack pinions.	Elevating racks.	Forged steel.	2	9	2½	...	16 teeth.
Elevating rack pinion cover.	Elevating rack pinion.	Sheet steel.	2			...	
Elevating hand-wheels.	At sides of chassis on elevating shaft.	Wrought iron, cast-iron hub.	2	40		...	
Elevating clamp.	At sides of chassis to elevating gear.	Cast steel.	(1)			...	
Elevating clamp bolt.	Elevating clamp.	Wrought iron.	1	1	16	2	With washer.
Elevating clamp spring.	do .....	Steel.	1			...	
Elevating clamp pulley.	do .....	Cast iron.	1	10½	3½	...	
Elevating arm truss.	Between rear elevating arms.	Cast steel.	1	27½	56.5	...	
Elevating band.	On gun.	Cast steel, No. 1.	1	30	7	...	

*Names of the parts of the 8-inch disappearing carriage, L. F., model of 1894, with their location, and the material of which they are made—Continued.*

Names of parts.	Location.	Material.	Number.	Diameter of width.	Length.	Nuts.	Remarks.
Elevating arm boxes.	Upper ends rear elevating arms.	Bronze, No. 1	2	In.	In.		4 halves.
Elevation pointer.	At elevating spur wheel, right side of carriage.	Bronze.	1				
Elevation pointer bracket.	Left chassis.	do.	1				
Emptying coupling.	Equalizing press pipe.	do.	1		4½		
Do.	Throttling pipes.	do.	1				
Emptying coupling plug.	Emptying coupling.	Wrought iron.	1	½	½		
Emptying coupling straps.	do.	do.	2				
Emptying plug.	Traversing worm pocket.	Cast iron.	1				½-inch gas tap.
Equalizing pressure pipe.	Recoil cylinders.	Copper.	1				In two parts.
Equalizing pressure pipe connections.	do.	Steel.	2				
Equalizing pipe rings.	Emptying coupling.	do.	2	1½			Free on pipe.
Equalizing pipe collars.	do.	Brass.	4	1½			Brazed on pipe.
Equalizing pipe straps.	Equalizing pipe.	Wrought iron.	2	1½			
Extractors.	For removing stuffing-box glands.	Steel.	2		10		
Eyebolts.	Upper end gun levers.	Wrought iron.	2	2	3½		
Flexible vulcanized fiber packing.	Emptying coupling.	Flexible vulcanized fiber.	4				
Filling and vent plugs.	Recoil cylinder.	Bronze, No. 3.	4				
Firing box bracket.	Right chassis.	Bronze.	1				
Followers.	Front stuffing boxes.	do.	2	6	6½		
Do.	Rear stuffing boxes.	do.	2	8½	3½		
Do.	Emptying coupling.	do.	2		1½		
Fulcrums.	For tripping bars.	Wrought iron.	2	1½	7½	2	
Fulcrum pins.	At sides of chassis for pinch bar.	Steel.	6	2	5½		
Garlock waterproof hydraulic packing.	Throttling pipes.	Garlock waterproof hydraulic.	15	½ sq.			
Do.	Stuffing boxes.	do.	16	½ sq.			
Gaskets.	Front stuffing boxes.	Leather.	2	8			
Do.	Rear stuffing boxes.	do.	2	12½			
Gears, miter.	Traversing clamp.	Bronze.	4				12 teeth each.
Glands.	Front stuffing boxes.	do.	2				
Do.	Rear stuffing boxes.	do.	2				
Do.	Equalizing pressure pipe, outer ends.	Steel.	2	1½	½		
Gun levers.	Carrying gun.	Cast steel, No. 1.	2	6	124		
Gun-lever axle.	Uniting gun levers.	Forged steel, No. 3.	1	18	56½		
Grease cups.	Gun lever and gun-lever axle.	Bronze.	6				
Handle.	On right-hand side gun lever.	Wrought iron.	1				
Hand rail.	On right-hand recoil cylinders.	do.	1				
Hauling-down ropes.	Gun levers to hauling-down drums.	Hemp.	2				3-inch rope Manila, with hook attached.
Hauling-down drums.	On traversing worm shaft.	Cast iron.	2	8	8		
Hinge brackets.	Traversing clamp.	do.	2				
Hinge pins.	do.	Steel.	2	1	6½		
Handle.	Telescopic sight holder.	Bronze.	1				
Hook.	do.	Steel.	1				
Housing.	do.	do.	1				
Implement box.	With carriage.	Ash.	1	22	60		With lock and handles.
Ladder.	Rear sighting platform.	Wrought iron.	1	13	70½		
Ladder brace.	do.	do.	1				
Latch fulcrums.	Safety tripping device.	Steel.	2				

† Rings.

*Names of the parts of the 8-inch disappearing carriage, L. F., model of 1894, with their location, and the material of which they are made—Continued.*

Names of parts.	Location.	Material.	Number.	Diameter or	Length.	Nuts.	Remarks.
				width.			
				In.	In.		
Latch operating cams.	Safety tripping device	Steel	2				
Lever	Elevating clamp	do.	1		20		
Leveling screws	Traverse circle	Bronze, No. 3.	20	1½	3		
Do.	Base ring	do.	16	1½	3½		
Lifting bolts	For lifting cylinder heads and trunnion caps.	Wrought iron.	2		5		
Liners	On chassis at crosshead run.	Bronze	2		35½		
Locking nut	Traversing worm wheel	do.	1				With spring click.
Locking screws	Front stuffing box	Steel	2	¾	1.6		
Name plate	On right chassis	Bronze	1				With two round-head screws.
Nut	Telescopic sight holder	Steel	1				
Nuts	Grease cup	Bronze	6	(1)		¾	
Oil can	With carriages	Brass	1				1 quart.
Do.	do.	do.	2				½ pint.
Oil plugs	do.	do.	10				½-inch tap.
Do.	do.	do.	41				¾-inch tap.
Do.	Crosshead pawl latch	do.	2				
Packing	Grease cup	Leather	6				
Packing rings	Emptying coupling	do.	2	1½			
Pawl latch cams	Safety tripping device	Steel	2				
Pawl latch pins	do.	do.	2				
Pawl latch springs	do.	do.	2				
Pawl latch-spring pins	Pawl latch	do.	4				
Pawl spring thimbles	At tripping pawls	Forged steel	2				
Pawl stops	do.	Steel	2			2	
Pawls, stationary	do.	Forged steel, No. 3.	2		20½		1 right-hand, 1 left-hand.
Pawls, movable	do.	do.	2		20½		Do.
Pawl springs	do.	Brass	4				
Pawl spring covers	do.	Steel and brass.	4	1½	3½		
Pins	Azimuth circle to traverse circle.	Bronze					
Pipe plugs	Filling and vent holes	Brass	6				½-inch pipe plugs.
Do.	At rear stuffing boxes	do.	2				Do.
Pin	Elevating clamp straps	Steel	1			2	1 1-inch nut, 1 1½-inch nut, and 1 washer.
Pins (for nut)	Grease cup	do.	6				
Pin	Elevating clamp lever	Forged steel, No. 2.	1				1 bronze washer.
Pistons and rods	In recoil cylinders	Forged steel, No. 3.	2		140	4	With bronze liners.
Piston plate	Piston rod	Bronze	2				
Platform, chassis sight.	Rear of right chassis	Wrought iron	1	23	24		
Platform braces	Chassis-sight platform	do.	(2)				
Do.	Trunnion platform	do.	(2)				
Platform, trunnion sight.	On top carriage	do.	1	18½	20		
Plug	Emptying coupling	Steel	1				
Racer	On traversing rollers	Cast steel, No. 1	1	96	9½		
Racer clip	On racer	Forged steel, No. 2.	1	9½	24		
Railing, chassis sight.	Rear-sight platform	Wrought iron				4	½-inch and 1-inch pipe.
Ratchet levers	Hand levers to tripping pawls.	Forged steel, No. 2.	2		60		1 right-hand, 1 left-hand.
Ratchet cranks	Carrying tripping pawls	Forged steel, No. 3.	2		19½		1 right-hand, 1 left-hand.
Ratchet-crank pins	In ratchet cranks	do.	2				
Recoil rollers	In upper part of chassis	do.	18	8	5		Each bronze-bushed.
Recoil-roller axles	do.	do.	18	2	8½		
Retraction sheave	Bracket	Cast steel, No. 1	1				
Rod	Telescopic sight holder	Steel	1				
Rollers (bushing)	Traversing wheel axle	do.	64	1½	4½		In 3 segments.
Roller dust guard	Around racer	Steel plate	1	9½			

1 1.06 across flats.

2 1 pair.

Names of the parts of the 8-inch disappearing carriage, L. F., model of 1894, with their location, and the material of which they are made—Continued.

Names of parts.	Location.	Material.	Number.	Diameter or width.	Length.	Nuts.	Remarks.
				In.	In.		
Screws.....	Grease cup.....	Bronze.....	6				
Do.....	Safety tripping device.....	Steel.....	2	0.5	1.5		
Do.....	For cover on sight standard.....	do.....	4	1.875			
Screws, set.....	Elevating band.....	do.....	2	2	5½		Special.
Screws, headless.....	Ratchet-crank pin.....	Wrought iron.....	2				
Do.....	Crank-shaft collar.....	Steel.....	1				
Screws, roundhead.....	Name plate.....	Wrought iron.....	2				
Do.....	Traversing wheel dust guards.....	do.....	160				
Do.....	Worm wheel dust guard.....	do.....	7	¾	1½		
Do.....	do.....	do.....	11	¾	1½		
Do.....	Traversing index finger.....	do.....	2				
Screws, counter-sunk.....	Graduated strip to elevating spur wheel.....	Brass.....	28	¾	1½		
Do.....	Crosshead liner gibs.....	Bronze.....	4		1½		
Do.....	Crosshead liners.....	do.....	36		1½		
Do.....	Piston plate.....	Steel.....	12		1½		
Sheaves.....	At upper ends of gun levers and rear of chassis.....	Cast iron.....	8				Bronze-bushed.
Sheave shafts.....	In hauling down sheaves.....	Forged steel.....	4	1½	5½		Each with taper pin.
Shot tongs.....	With carriage.....	Steel.....	7				
Sight binding screws.....	Sight-standard caps.....	Bronze.....	2				
Sight-retainercatch band.....	Used on Scott telescopic sights, model 1898 and 1898 M1.....	do.....	1				
Sight-standard caps.....	On sight standard.....	Cast iron.....	2				
Sight standard.....	On rear of right chassis.....	Cast steel.....	1		35		
Split pin.....	On crank sight holder.....	Steel.....	1	¾			
Do.....	do.....	do.....	1	¾			
Spring.....	Telescopic sight holder.....	Steel wire, No. 12 A. W. G.....	1				9 coils.
Do.....	Grease cup.....	Steel.....	6				
Spring bolt.....	do.....	Bronze.....	6				
Sprocket wheel.....	Traversing gear bracket.....	Cast iron.....	1	9.5			
Sprocket-wheel shaft.....	do.....	Steel.....	1		29½		
Sprocket wheel.....	Traversing gear bracket.....	Cast iron.....	1	9.5			
Sprocket-wheel shaft.....	do.....	Steel.....	1		29½		
Stationary pawl studs.....	At tripping pawls.....	Forged steel, No. 3.....	2				
Step.....	At fulcrum pin on right-hand side of chassis.....	Steel.....	1				
Do.....	At right-hand side of chassis.....	Wrought iron.....	2				4
Stop.....	Telescopic sight holder.....	Steel.....	1				
Stop plates.....	On elevating rack guides.....	do.....	2				
Stop pins.....	On elevating racks.....	do.....	2				
Stop nut.....	Sprocket-wheel shaft.....	do.....	1				
Studs.....	Rear heads, recoil cylinders.....	Wrought iron.....	24	¾	2½	24	
Do.....	At gun-lever caps.....	do.....	4	1½	6½	4	
Do.....	At caps to elevating arms.....	do.....	4	1	4	4	
Stuffing boxes.....	Front ends, top carriage.....	Bronze.....	2				
Do.....	Rear ends, top carriage.....	do.....	2				
Suspension rods.....	Supporting counterweight.....	Forged steel, No. 3.....	2	3½	63½	4	
Suspension-rod shaft.....	Through suspension rods.....	do.....	1	6	49		
Taper pins.....	In hauling down sheave shafts.....	Steel.....	4				
Telescopic sight holder.....	Sight standard.....	Bronze.....	1				
Terminal niche cover.....	Platform.....	Structural steel.....	1				
Throttling pipe.....	Top carriage.....	Copper.....	1				In 3 parts.
Throttling connection.....	Throttling pipe.....	Bronze.....	2				
Throttling packing.....	do.....	Flexible fiber vulcanized.....	2				
Throttling valve.....	do.....	Bronze.....	1				
Throttling-valve stem.....	do.....	Steel and bronze.....	1				In 2 parts
Throttling-valve seat.....	do.....	Steel.....	1				

*Names of the parts of the 8-inch disappearing carriage, L. F., model of 1894, with their location, and the material of which they are made—Continued.*

Names of parts.	Location.	Material.	Number.	Diameter or width.	Length.	Nuts.	Remarks.
				In.	In.		
Throttling gland...	Throttling pipe.....	Bronze.....	1				
Throttling yoke...	do.....	do.....	1				
Throttling latch.....	do.....	do.....	1				
Throttling bars.....	Recoil cylinders.....	Forged steel.....	4				
Thrust plates.....	Under traversing circle leveling screws.	Steel.....	36	4	4		
Top carriage.....	On chassis.....	Gun iron.....	1	77	64		
Top-carriage caps.....	On top carriage.....	Cast steel, No. 1.....	2				
Traversing circle.....	On platform.....	Gun iron.....	1	32	95		In 4 segments.
Traversing circle joint plates.	Under traversing circle.....	Steel.....	3				
Traversing wheel stops.	On traversing circle.....	do.....	2				
Traversing rollers..	Between base ring and racer.	Forged steel No. 3.....	18	6	11½		
Traversing wheels.	On traversing circle.....	Cast steel, No. 1.....	4	16			
Traversing wheel axles.	In traversing wheels.....	Forged steel, No. 3.....	4	3½	11½		
Traversing wheel transom.	Carrying rear of chassis...	Cast steel, No. 1.....	1	42	100		
Traversing gear wheels.	At rear outside chassis....	Bronze.....	2	15.1			70 teeth.
Do.....	do.....	do.....	2	7.77			18 teeth.
Traversing gear bracket.	On traversing wheel transom.	Cast iron, No. 2.....	1	14½	33		
Traversing clamp jaws.	Traversing clamp.....	Cast steel.....	2	6	12		1 right-hand, 1 left-hand.
Traversing clamp screw.	do.....	Steel.....	1		14½		
Traversing clamp crank.	Steel.....	Wrought iron.....	1				With brass sleeve.
Traversing cranks.	Traversing worm shaft....	do.....	2				Do.
Traversing worm.	Traversing gear bracket...	Steel.....	1				
Traversing worm wheel.	do.....	Bronze, No. 1.....	1	14½	4		20 teeth.
Traversing worm shaft.	Rear of chassis.....	Steel.....	1		90½		
Traversing crank spindles.	do.....	do.....	2		20½		
Traversing index finger.	On right end of traversing wheel transom.	Sheet brass.....	1				2 dowel pins.
Traversing chain..	Around traversing circle..	Wrought iron.....	1				With take-up bolt and clevis.
Traversing chain eyebolts.	In traversing circle.....	do.....	2				
Transom, front....	Between chassis.....	Cast steel, No. 1.....	1	29	52		
Transom, rear.....	do.....	do.....	1	42	52		
Tripping bars.....	With carriage.....	Steel.....	2		54		
Tripping-bar hooks	On outside of chassis.....	Wrought iron.....	4				
Washer.....	Telescopic sight holder.....	Steel.....	1				
Do.....	Grease cup.....	Bronze.....	6				
Washer.....	On hauling-down sheave shafts.	Forged steel.....	4				
Do.....	Elevating-rack trunnion..	Bronze.....	2	5½			1½-inch hole.
Do.....	At chain pulley brackets..	Steel.....	2	3½			With dowel pins.
Do.....	Elevating clamp.....	Wrought iron.....	1	3			1½-inch hole.
Wire netting.....	Rear sighting platform.....	do.....	1				
Wrench.....	For rear stuffing box.....	Steel.....	1				
Do.....	For rear stuffing-box follower.	do.....	1				
Do.....	For front stuffing box.....	do.....	1				
Do.....	For cylinder-head nuts.....	do.....	1		12		
Do.....	For suspension-rod nuts...	do.....	2		42		
Wrench, double....	For ½-inch and ¾-inch nuts.	do.....	1				
Do.....	For ¾-inch and 1-inch nuts.	do.....	1				
Do.....	For 1-inch and 1-inch nuts.	do.....	1				
Do.....	For 1½-inch and 1-inch nuts.	do.....	1				
Do.....	For 1½-inch and 1½-inch nuts.	do.....	1				
Do.....	For 1½-inch and 1½-inch nuts.	do.....	1				
Wrench, single....	For 2-inch nuts.....	do.....	1				
Do.....	For piston-rod nuts.....	do.....	2				
Wrench, connection.	For assembling equalizing pipe connection.	Wrought iron.....	1		11		
Yale standard padlock and key.	Throttling pipes.....	Bronze.....	2				

Names of the parts of the 8-inch disappearing carriage, L. F., model of 1894, with their location, and the material of which they are made—Continued.

## AMMUNITION TRUCK.

[Three trucks for each carriage.]

Names of parts.	Location.	Material.	Number.	Diameter or width.	Length.	Nuts.	Remarks.
Adjusting sleeve...	On rear elevating screw...	Bronze.....	1	In. 3½	In. 9		
Adjusting hand-wheels.	.....do.....	.....do.....	1				
Ball bearings.....	Caster yokes.....	Steel.....	2				19 steel balls, ¼ inch, and bronze cover.
Do.....	Elevating wheel hub.....	.....do.....	1				15 steel balls, ½ inch, and bronze cover.
Do.....	.....do.....	.....do.....	1				24 steel balls ½ inch and bronze cover.
Bolts.....	Caster bracket.....	Wrought iron.	4		1.6	4	
Do.....	.....do.....	.....do.....	2		1½		
Do.....	Front axle.....	.....do.....	3		2½	3	
Cartridge shelves.	On sides of truck.....	Steel.....	2				
Cartridge-shelf supports.	Under front ends of cartridge shelves.	.....do.....	2				1 by 1 by ½ inch angle.
Do.....	Rear ends of cartridge shelves.	.....do.....	2		4½		1½ by 1½ by ¼ inch angle.
Caster wheels.....	Rear of truck.....	Cast steel.....	2				
Caster yokes.....	Caster wheels.....	.....do.....	2			2	
Caster brackets.....	Connecting caster yoke to body of truck.	Cast steel.....	2				1 right-hand, 1 left-hand.
Caster pins.....	Through caster yokes.....	Steel.....	2		4.15	2	2 split pins.
Crank.....	On left side of body of truck.	Wrought iron.	1				With brass sleeve.
Crank shaft.....	Through upper part of body of truck.	Steel.....	1				
Crank-shaft bushing.	Bearing crank shaft.....	Bronze.....	2				
Elevating screws..	Carrying shot tray.....	Steel.....	2				1 right-hand, 1 left-hand.
Elevating wheel...	On adjusting sleeve.....	Bronze.....	1				32 teeth, 3½-inch bore.
Do.....	On front elevating screw.....	.....do.....	1				32 teeth, hub threaded.
Elevating pinion...	On crank shaft.....	Steel.....	1				15 teeth and 2 ½-inch set screws.
Filling-in piece....	At hinge for handles.....	Wrought iron.	2				
Filler piece.....	Rear end of shot tray.....	Cast steel.....	1				
Filler-piece hinge..	.....do.....	.....do.....	1				
Filler-piece hinge pin.	.....do.....	Steel.....	1				With split pins.
Frame.....	Forming body of truck.....	Wrought iron.	1				1½ by 1½ by ¼-inch angle iron.
Do.....	Under supporting shelves.	.....do.....	2				1½ by 1½ by ¼-inch angle iron.
Front wheels.....	On front axle.....	Cast steel.....	2				
Front axle.....	At base of truck.....	Steel.....	1			2	2 washers, 2 split pins.
Handle.....	At rear of truck.....	Wrought iron and wood.	(1)				
Hinges.....	Connecting handles.....	Wrought iron.	2				1 right-hand, 1 left-hand.
Hinge pin.....	.....do.....	.....do.....	1	½	12		2 washers, 2 split pins.
Nuts.....	On caster yokes.....	.....do.....	2	1	1	2	2 washers.
Do.....	On caster pins.....	.....do.....	2	1	1	2	2 split pins.
Do.....	Front axle.....	.....do.....	2	1	1	2	Do.
Do.....	On crank shaft.....	.....do.....	1	½	1	1	
Oil plugs.....	Front-wheel hubs.....	Bronze.....	2				0.375-inch tap.
Do.....	Caster wheels.....	.....do.....	2				Do.
Do.....	Caster yokes.....	.....do.....	2				Do.
Reinforcing ring...	In top plate.....	Forged steel..	1	7			
Do.....	.....do.....	.....do.....	1	4½			
Roller bearing.....	Caster-wheel hubs.....	Steel and bronze.	2	1½	2½		
Do.....	Front-wheel hubs.....	.....do.....	2	1½	2½		
Screws, headless...	Elevating pinion.....	Steel.....	2	½	.95		
Screws, roundhead	Adjusting handwheel stop.	Brass.....	2	½	½		
Do.....	Ball-bearing cover.....	Wrought iron.	6	½	½		
Do.....	.....do.....	.....do.....	6	½	½		

1 pair.

*Names of the parts of the 8-inch disappearing carriage, L. F., model of 1894, with their location, and the material of which they are made—Continued.*

Names of parts.	Location.	Material.	Number.	Diameter or	Length.	Nuts.	Remarks.
				width.			
Shot tray.....	On elevating screws.....	Wrought iron.	1	<i>In.</i>	<i>In.</i>		
Shot-tray pins.....	Connecting shot tray to elevating screws.	Bronze.....	2	1	4½		2 split pins.
Stop.....	Adjusting sleeve.....	Steel.....	1	½	.6		
Do.....	Adjusting handwheel.....	do.....	1		1½		
Supporting shelf...	In top plate.....	do.....	1				Bored 1.85 inches diameter.
Do.....	do.....	do.....	1				Bored 3½ inches diameter.
Top plate.....	Top of body of truck.....	do.....	1				

WAR DEPARTMENT,  
OFFICE OF THE CHIEF OF ORDNANCE,  
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## INDEX.

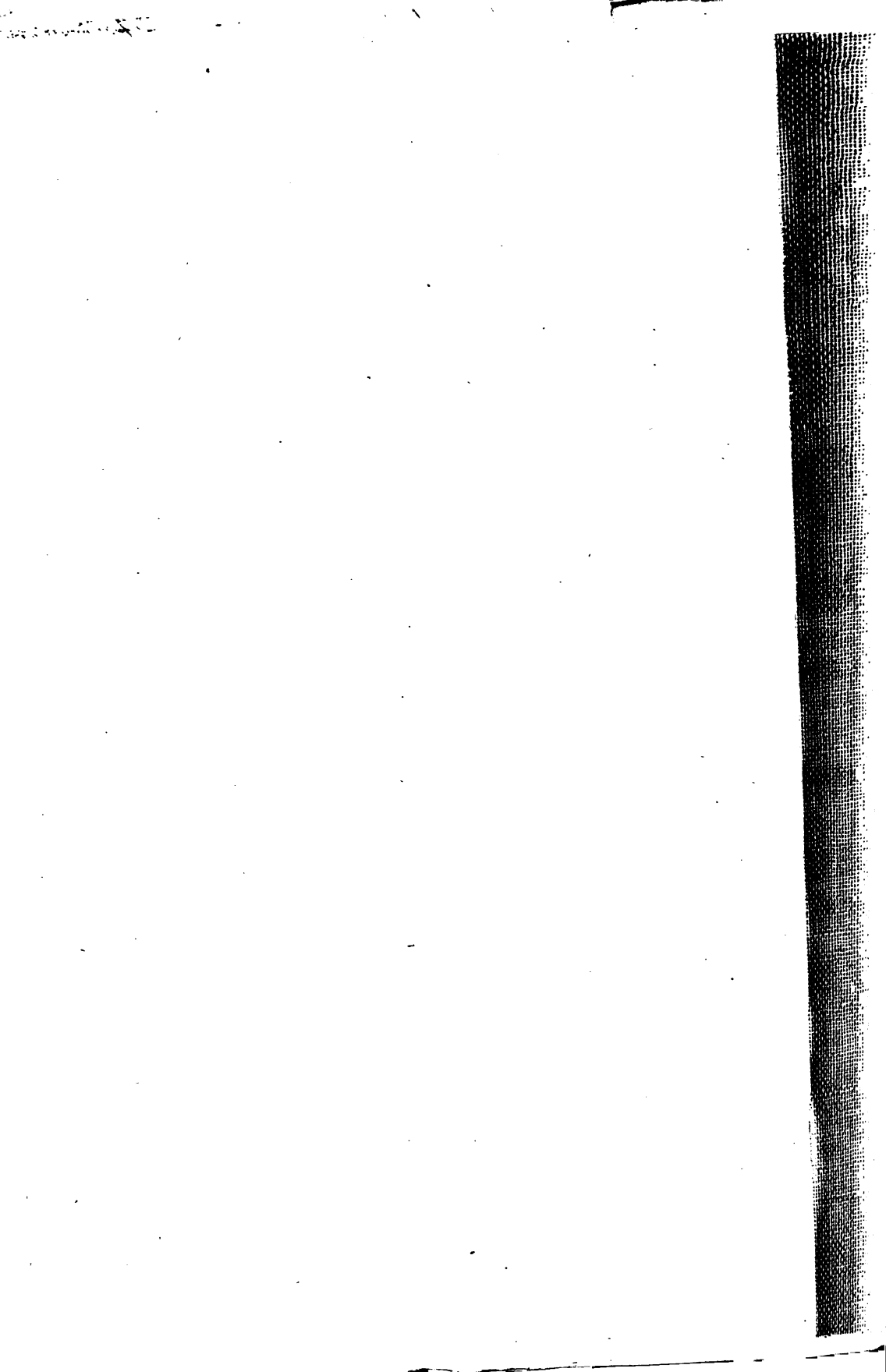
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	Page.
Ammunition, how served.....	16
Ammunition trucks, number furnished.....	17
Articles:	
Furnished by Engineer Department.....	17
Packed in, list—	
Armament chest.....	28
Implement boxes.....	29
Azimuth, pointing of, method.....	14
Azimuth circle, location and description.....	13
Azimuth pointer and subscale.....	13
Base ring:	
Description and location.....	13
Leveling, etc.....	19
Boxes:	
Implement, articles packed in, list.....	29
Stuffing—	
Removing packing from, method.....	26
Repacking, instructions.....	26
Carriage:	
Action.....	17
Care of, general instructions.....	25-28
Parts of.....	9
To assemble, instructions.....	18-24
Weight of parts, table.....	29
Chassis, description.....	12
Chest, armament, articles packed in, list.....	28
Counter-recoil buffers, description.....	12
Counterweight:	
Amount furnished with each carriage.....	17
Location.....	9
Counterweight bottom plate, location.....	9
Elevating arms, description, etc.....	16
Elevating rack, description.....	16
Elevating-rack pinion, location.....	15
Equalizing pipe, arrangement.....	11
Extractor bars, use.....	26
Gaskets and packing, number furnished.....	29
Cups, grease, compression:	
Filling.....	28
Use.....	17
Gun levers, description.....	9
Implements furnished, list.....	29
Oil, kind and quantity to be used.....	16
Oil holes, precautions against dirt, etc.....	28
Padlocks, where used.....	12

**Parts:**

Names of, location, etc.....	
Weights, table.....	
Pawls, description, location, etc.....	
Plates, list.....	
Pointing in elevation, how effected.....	
Points to be noted after carriage is assembled.....	
Principal parts.....	
Projectile tray, arrangement.....	
Racer, description and location.....	
Recoil cylinders:	
Cleaning, instructions.....	
Description, size, etc.....	
Filling, method.....	
Not to remain empty.....	
Recoil buffers, location.....	
Safety lanyard attachment, description.....	
Service condition (lubrication, etc.), instructions.....	
Sight retainers, description.....	
Sight standard, position.....	
Sighting platforms, location.....	
Sprocket-wheel shaft, description.....	1
Throttling bars, description.....	1
Throttling valve, adjustment and description.....	1
Top carriage, description.....	1
Trunnions, location.....	
Weights of parts, table.....	2
Worm wheel, description.....	1





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